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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/772,777	02/05/2004	Theodorus E. Standaert	2002 P 17753 US (BHGL No.	2367

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EXAMINER

NOVACEK, CHRISTY L

ART UNIT	PAPER NUMBER
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2822

DATE MAILED: 05/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/772,777

Applicant(s)

STANDAERT ET AL.

Examiner

Christy L. Novacek

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 February 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This office action is in response to the communication filed February 5, 2004.

Specification

The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: Claims 14 and 19 recite the limitation of “a dielectric hardmask”. The specification does not disclose forming a hardmask made of a dielectric material.

Claim Objections

Claims 16, 21, 23 and 25 are objected to because of the following informalities: Claims 16, 21, 23 and 25 are directed to a product made by the method disclosed in claims 1, 17, 22 and 24, respectively. As is stated in MPEP section 608.01, “if claim 1 recites a method of making a specified product, a claim to the product set forth in claim 1 would not be a proper dependent claim if the product might be made in other ways.” Regarding claim 16, the product can be made by providing a liner material on the feature after the step of etching the dielectric portion, instead of by the method disclosed in claim 1. Regarding claim 21, the product can be made by providing a liner material on the feature in a CVD chamber, instead of by the method disclosed in claim 17. Regarding claim 23, the product can be made by providing a metallic liner on the feature after the RIE step, instead of by the method disclosed in claim 22. Regarding claim 25, the product can be made by providing a liner material on the feature in a CVD chamber, instead of by the method disclosed in claim 24. Appropriate correction is required.

Claim Rejections - 35 USC § 102

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The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 8-12, 16, 17 and 21 are rejected under 35 U.S.C. 102(e) as being anticipated by You et al. (US 6,663,787).

Regarding claims 1 and 16, You discloses providing a dielectric portion (112/114/113), etching the dielectric portion to produce a feature, during said etching step providing on the feature a liner material (119) to produce a lined feature, and depositing a conductive material (122) on the lined feature (Fig. 4D-4G; col. 13, ln. 25 – col. 16, ln. 26).

Regarding claim 8, You discloses the dielectric portion includes a low-k dielectric (col. 14, ln. 27-28).

Regarding claim 9, You discloses the dielectric portion includes an organic dielectric (col. 14, ln. 28-33).

Regarding claim 10, You discloses providing a seed layer on the liner material before depositing the conductive material (col. 15, ln. 65-67).

Regarding claim 11, You discloses the conductive material is copper (col. 16, ln. 1-7).

Regarding claim 12, You discloses the feature can be a trench or a via hole (col. 16, ln. 51-63).

Regarding claims 17 and 21, You discloses providing a dielectric portion (112/114/113), in an etch chamber, etching the dielectric portion to produce a feature, in the etch chamber, providing on the feature a liner material (119) to produce a lined feature, and depositing a conductive material (122) on the lined feature (Fig. 4D-4G; col. 13, ln. 25 – col. 16, ln. 26).

Claims 1, 2, 8-12, 16, 17 and 21 are rejected under 35 U.S.C. 102(b) as being anticipated by Layadi et al. (US 6,180,518).

Regarding claims 1 and 16, Layadi discloses providing a dielectric portion (54/56/58), etching the dielectric portion to produce a feature, during said etching step providing on the feature a liner material (64) to produce a lined feature, and depositing a conductive material (70) on the lined feature (Fig. 2-6; col. 3, ln. 1 – col. 5, ln. 64).

Regarding claim 2, Layadi discloses that the etching step includes reactive ion etching (col. 4, ln. 20 – col. 5, ln. 33).

Regarding claim 8, Layadi discloses that the dielectric portion includes a low-k dielectric (col. 3, ln. 36-41).

Regarding claim 9, Layadi discloses that the dielectric portion includes an organic dielectric (col. 3, ln. 48-50).

Regarding claim 10, Layadi discloses providing a seed layer (68) on the liner material before depositing the conductive material (col. 5, ln. 54-55).

Regarding claim 11, Layadi discloses the conductive material is copper (col. 5, ln. 61-63).

Regarding claim 12, Layadi discloses the feature can be a via hole (col. 4, ln. 13-15).

Regarding claims 17 and 21, Layadi discloses providing a dielectric portion (54/56/58), in an etch chamber, etching the dielectric portion to produce a feature, in the etch chamber, providing on the feature a liner material (64) to produce a lined feature, and depositing a conductive material (70) on the lined feature (Fig. 2-6; col. 3, ln. 1 – col. 5, ln. 64).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Layadi et al. (US 6,180,518) in view of Lin et al. (US 6,743,732).

Regarding claim 13, Layadi discloses etching the dielectric portion using reactive ion etching (RIE), but Layadi does not disclose a RIE apparatus used to carry out the etching. Lin discloses that a TEL SCCM etch tool can successfully be used to etch a dielectric portion (col. 3, ln. 40-46). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the TEL SCCM apparatus of Lin to conduct the RIE of Layadi because Lin teaches that this apparatus can successfully be used to reactive ion etch a dielectric portion.

Claims 14, 15, 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Layadi et al. (US 6,180,518).

Regarding claims 14 and 19, Layadi discloses etching through a dielectric hardmask using a pressure of 30-70mTorr, a power level of 500-700 watts, an Ar flow rate of 75-125 sccm,

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an O₂ flow rate of less than about 25 sccm, and a CHF₃ flow rate of 25-75 sccm (col. 4, ln. 65 – col. 5, ln. 8). Layadi states that the flow rate of argon and oxygen depend upon the size of the via and the desired thickness of the liner. At the time of the invention, it would have been obvious to one of ordinary skill in the art to form use routine experimentation to determine appropriate parameters for the etching of the dielectric hardmask because Layadi states that parameters may be varied because such variables of art recognized importance are subject to routine experimentation and discovery of an optimum value for such variables is obvious. See *In re Aller*, 105 USPQ 233 (CCPA 1955).

Regarding claims 15 and 20, Layadi discloses reactive ion etching an organic portion of the dielectric portion using an etch gas that is a mixture of N₂ and H₂, but does not disclose the etch parameters (col. 4, ln. 25-26). At the time of the invention, it would have been obvious to one of ordinary skill in the art to form use routine experimentation to determine appropriate parameters for the etching of the organic dielectric because such variables of art recognized importance are subject to routine experimentation and discovery of an optimum value for such variables is obvious. See *In re Aller*, 105 USPQ 233 (CCPA 1955).

Claims 2-7, 18 and 22-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over You et al. (US 6,663,787) in view of Dalton et al. (US 20010036753).

Regarding claims 2-7, You does not disclose using reactive ion etching to etch the metal hardmask of TaN. Like You, Dalton discloses etching a layer of TaN. Dalton states that the TaN layer can be successfully etched by using a RIE method with a gas of CF₄ (a fluorocarbon) (para. 0031-0032). Dalton states that this etching method and etch chemistry allows the TaN to be etched selectively relative to a copper alloy or an aluminum alloy (para. 0032). At the time of

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the invention, it would have been obvious to one of ordinary skill in the art to etch the TaN layer of You using the RIE method disclosed by Dalton because Dalton states that this etching method can be used to selectively etch TaN relative to a copper or aluminum alloy layer, as is required in the invention of You.

Regarding claim 18, You discloses that the liner is a metallic liner and that the liner providing step involves redepositing sputter products from a metal hardmask but You does not disclose using reactive ion etching to etch the metal hardmask. Like You, Dalton discloses etching a layer of TaN. Dalton states that the TaN layer can be successfully etched by using a RIE method with a gas of CF₄ (a fluorocarbon) (para. 0031-0032). Dalton states that this etching method and etch chemistry allows the TaN to be etched selectively relative to a copper alloy or an aluminum alloy (para. 0032). At the time of the invention, it would have been obvious to one of ordinary skill in the art to etch the TaN layer of You using the RIE method disclosed by Dalton because Dalton states that this etching method can be used to selectively etch TaN relative to a copper or aluminum alloy layer, as is required in the invention of You.

Regarding claims 22 and 23, providing a low-k dielectric portion, etching the low-k dielectric portion to produce a feature, during the etching step providing a metallic liner on the feature to produce a lined feature, and depositing copper on the lined feature. You does not disclose using reactive ion etching to provide the metallic liner. Like You, Dalton discloses etching a layer of TaN. Dalton states that the TaN layer can be successfully etched by using a RIE method with a gas of CF₄ (a fluorocarbon) (para. 0031-0032). Dalton states that this etching method and etch chemistry allows the TaN to be etched selectively relative to a copper alloy or an aluminum alloy (para. 0032). At the time of the invention, it would have been obvious to one

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of ordinary skill in the art to etch the TaN layer of You using the RIE method disclosed by Dalton because Dalton states that this etching method can be used to selectively etch TaN relative to a copper or aluminum alloy layer, as is required in the invention of You.

Regarding claims 24 and 25, You discloses providing a low-k dielectric portion, in an etch chamber, etching the low-k dielectric portion to produce a feature, in the etch chamber, providing a metallic liner on the feature to produce a lined feature, and depositing copper on the lined feature. You does not disclose using reactive ion etching to provide the metallic liner. Like You, Dalton discloses etching a layer of TaN. Dalton states that the TaN layer can be successfully etched by using a RIE method with a gas of CF₄ (a fluorocarbon) (para. 0031-0032). Dalton states that this etching method and etch chemistry allows the TaN to be etched selectively relative to a copper alloy or an aluminum alloy (para. 0032). At the time of the invention, it would have been obvious to one of ordinary skill in the art to etch the TaN layer of You using the RIE method disclosed by Dalton because Dalton states that this etching method can be used to selectively etch TaN relative to a copper or aluminum alloy layer, as is required in the invention of You.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (571) 272-1839. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

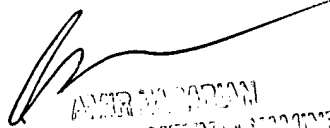
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CLN

April 28, 2005


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